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STOP-Bang Questionnaire

A Practical Approach to Screen for Obstructive Sleep Apnea

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There exists a high prevalence of OSA in the general population, a great proportion of which remains undiagnosed. The snoring, tiredness, observed apnea, high BP, BMI, age, neck circumference, and male gender (STOP-Bang) questionnaire was specifically developed to meet the need for a reliable, concise, and easy-to-use screening tool. It consists of eight dichotomous (yes/no) items related to the clinical features of sleep apnea. The total score ranges from 0 to 8. Patients can be classified for OSA risk based on their respective scores. The sensitivity of STOP-Bang score ≥ 3 to detect moderate to severe OSA (apnea-hypopnea index [AHI] > 15) and severe OSA (AHI > 30) is 93% and 100%, respectively. Corresponding negative predictive values are 90% and 100%. As the STOP-Bang score increases from 0 to 2 up to 7 to 8, the probability of moderate to severe OSA increases from 18% to 60%, and the probability of severe OSA rises from 4% to 38%. Patients with a STOP-Bang score of 0 to 2 can be classified as low risk for moderate to severe OSA whereas those with a score of 5 to 8 can be classified as high risk for moderate to severe OSA. In patients whose STOP-Bang scores are in the midrange (3 or 4), further criteria are required for classification. For example, a STOP-Bang score of ≥ 2 plus a BMI > 35 kg/m^2 would classify that patient as having a high risk for moderate to severe OSA. In this way, patients can be stratified for OSA risk according to their STOP-Bang scores.

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OSA is the most common type of sleep-disordered breathing. In OSA, repetitive episodes of partial and complete pharyngeal collapse cause a reduction or total cessation of airflow during sleep. The condition is associated with hypertension, cerebrovascular disease, myocardial infarction, diabetes, long-term cognitive impairment, and increased all-cause mortality.[1-3] This chronic sleep disturbance results in daytime sleepiness and fatigue that impedes a patient's ability to function, thereby negatively affecting his or her quality of life. The current prevalence rate of moderate to severe OSA (apnea-hypopnea index [AHI] ≥ 15 events/h) is about 10% to 20%.[4] This estimated prevalence rate represents a substantial increase over the past 2 decades.[4] Since these apnea and

ABBREVIATIONS: AHI = apnea-hypopnea index; NPV = negative predictive value; PPV = positive predictive value; PSG = polysomnogram; STOP-Bang = snoring, tiredness, observed apnea, high BP, BMI, age, neck circumference, and male gender

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hypopnea events occur during sleep, most patients with OSA may not be aware that they have the condition. It has been estimated that up to 80% of individuals with moderate to severe OSA may remain undiagnosed and, more alarmingly, untreated.[5]

The prevalence of OSA specifically found in surgical patients differs among various populations. The prevalence rate is approximately 70% in patients undergoing bariatric surgery[6] and 8.4% of orthopedic patients,[7] and 7.2% among patients undergoing a variety of surgeries.[8] Since 60% of surgical patients with moderate to severe OSA were not recognized or diagnosed preoperatively,[9,10] the point estimates from these studies may actually be an underestimation.

Because of the potentially serious adverse consequences associated with untreated OSA in the general and surgical population, prompt diagnosis and treatment of unrecognized OSA is critical. The reference standard for diagnosis of OSA is an overnight polysomnogram (PSG). However, the procedure is time-consuming, labor-intensive, and costly. Growing awareness of sleep apnea has extended the already long waiting lists in many sleep laboratories.[11] As a result, patients with OSA are currently left waiting a mean of 11.6 months before being able to initiate medical therapy (CPAP) and 16.2 months before being able to initiate surgical therapy in Ontario, Canada.[12] Moreover, PSG requires the expertise of sleep medicine specialists, who may not be readily available at many hospitals and medical centers. All of these factors exacerbate delays that can prevent prompt diagnosis and treatment of OSA, which further emphasizes the vital need for a simple, practical, and reliable method of identifying and triaging patients at high risk of OSA. In an effort to deal with this issue, a number of screening tests were developed to identify high-risk patients.[8,13-19] Many are lengthy and complicated, and require upper airway assessment, which makes them inconvenient to use and vulnerable to variability among clinicians performing the upper airway assessment.

The STOP and STOP-Bang Questionnaire

The snoring, tiredness, observed apnea, high BP (STOP) and snoring, tiredness, observed apnea, high BP-BMI, age, neck circumference and gender (STOP-Bang) questionnaires (e-Appendix 1) were developed in response to the need for a concise, user-friendly OSA screening tool in preoperative clinics.[20] The STOP questionnaire includes four questions related to snoring, tiredness, observed apnea and high blood pressure, and shows a moderately high level of sensitivity (65.6%) and specificity (60%) in detecting OSA (AHI $>$ 5) in surgical patients.[20] For moderate to severe OSA (AHI $>$ 15), the sensitivity and specificity of the STOP questionnaire are 74% and 53%, respectively. For severe OSA (AHI $>$ 30), sensitivity is 80% and specificity is 49%.[20]

The STOP-Bang questionnaire includes the four questions used in the STOP questionnaire plus four additional demographic queries,[20] for a total of eight dichotomous (yes/no) questions related to the clinical features of sleep apnea (snoring, tiredness, observed apnea, high blood pressure, BMI, age, neck circumference and male gender). For each question, answering "yes" scores 1, a "no" response scores 0, and the total score ranges from 0 to 8. The components of STOP questionnaire were selected based on the factor analysis of 14 candidate questions designed to reflect snoring, daytime tiredness, observed breathing cessation, and high BP.[20] The "Bang" items were chosen based on univariate analysis of item predictive performance. The diagnostic OR to detect OSA (AHI $>$ 5 events/h) was 1.949 (95% CI, 0.792-4.798) for BMI $>$ 35 kg/m^2; 4.024 (95% CI, 2.023-8.003) for age $>$ 50 years; 4.943 (95% CI, 1.963-12.446) for neck circumference $>$ 40 cm, and 2.767 (95% CI, 1.419-5.396) for male gender (F. C., unpublished data, February 2014).

The questionnaire can be completed quickly and easily (usually within 1-2 min), and overall response rates are typically high (90%-100%).[20] The questionnaire has demonstrated a high sensitivity using a cutoff score of $\geq$ 3: 84% in detecting any sleep apnea (AHI $>$ 5 events/h), 93% in detecting moderate to severe sleep apnea (AHI $>$ 15 events/h), and 100% in detecting severe sleep apnea (AHI $>$ 30 events/h).[20] Corresponding specificities were 56.4%, 43%, and 37%.[20] If patients score 0 to 2 on the STOP-Bang questionnaire, they are considered to be at low risk of OSA, and the possibility of those patients having moderate to severe sleep apnea can be confidently ruled out.

Because of its ease of use, efficiency, and high sensitivity, the STOP-Bang questionnaire has been widely adopted and validated in various populations and among patients with assorted medical conditions. It has been applied in sleep[21-30] and medical clinics,[31] surgical patients,[32,33] the general population,[34,35] pregnant patients,[36] individuals with mental illness,[37] highway bus drivers,[38-40] and patients with renal failure.[41]

Association Between STOP-Bang Scores and Predictive Probability of OSA

Although the high sensitivity of the STOP-Bang questionnaire makes it useful as an OSA screening tool,